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crossing points resistance is greatly increased, thus causing rapid burning and destruction at such points.

Such woods as Hickory and Rock-Elm furnish the very best of our timbers. They are the toughest and most durable of our woods; but they do not make good filaments. The medullary rays are very numerous and the walls of the cells composing them greatly thickened. The long, pointed, thick-walled wood-cells do not follow a parallel course, but interlace with each other. This interlacing of the cells gives to these woods their toughness. It is the main characteristic also which renders them worthless when made into electric filaments. Upon carbonization of such filaments the tension of the interlacing cells is relieved and the tissues composing it become friable and easily fall apart.

In the adult stem of the Bambusa a combination of anatomical characters has brought about a result which makes it the most fitting material so far as now known for the electric filament.

The nearly parallel fibro-vascular bundles grow more numerous as they approach the circumference of the stem and as is usual in similar stems lose most, or sometimes all, of the woody elements, thus becoming pure bast. The parenchymatic tissue which toward the center of the stem may be composed of a layer of five or six cells between the bundles, decreases in amount near the circumference until but one layer of cells remains. The walls of the cells in this single layer often become so thickened, and at the same time compressed by the growth of the bast, that these bundles appear to make a solid zone of bast around the circumference of the stem. The bast-cells also continue to thicken their walls until they become, in the best specimens for the filament, completely filled and solid.

It is from this zone of bast at the circumference of the stem that the filament is always taken.

The following characters will be found to exist in such a filament: Bast fibers solid; very compact without inter-cellular spaces; nearly parallel; joined together by mitred ends thus appearing as continuous fibres; the presence of a minimum amount of parenchyma possible in such filament; a sufficient amount of cohesion between the separate fibres to often cause the separation of bast-cells in halves upon splitting the material.

These characters secure the least possible diversification of cells, *i.e.*, the most homogeneous structure which can be secured where long, solid fibers are sought. This filament is perhaps the nearest approach, in its continuity of structure and uniform character, to a metallic conductor of any tissue which can be found in the vegetable kingdom.

The Botany of the Bahamas.—PROF. CHARLES S. DOLLEY remarked that the list of Bahama plants which he presented for publication this evening represents one hundred and fifteen families, four hundred and ten genera, and six hundred and twenty-one species. One-third of the families (forty-seven) are represented by but one or two species each, another third by five species or less. Nearly two-thirds of the genera have but one representative.

In order of importance, or number of species, the families are *Leguminosæ*, fifty-three sp.; *Euphorbiaceæ*, thirty-five sp.; *Compositæ*, thirty-two sp.; *Gramineæ*, thirty-two sp.; *Rubiaceæ*, twenty-three sp.; *Malvaceæ*, eighteen sp. The genera having the largest number of species are *Croton*, *Epidendron*, *Euphorbia*, *Passiflora* with eight species each; *Acacia*; *Cassia*, *Citrus*, *Eugenia*, *Ipomœa*, *Solanum* and *Tillandsia*, with six species each, and *Anona*, *Cereus*, *Cyperus*, *Eupatorium*, each with five species. Nearly one-third of the total number of species are of economic value; of those possessing medicinal properties there are forty-five astringents, thirty-four tonics, twenty-five purgatives and twenty-one diuretics.

A comparison of the Bahama–phænogamic flora with that of the Bermudas shows eighty-two families and one hundred and ninety-five species common to the two groups of islands.

While a large per centage of the flora is undoubtedly common to Florida and the neighboring islands of the West Indies, fully one-third of the species listed may be considered indigenous.

Unfortunately no tract similar to the "Walsingham tract" of the Bermudas has yet been found, in which the indigenous vegetation of the group remains undisturbed in the possession of the orginal surface.

The present rocks are æolian in formation, and the contained fossils resemble present species, facts which indicate the recent character of the Bahamas.

That the older vegetation has been exterminated by wind and water erosion and by subsidence, and that it, in its turn, grew upon a surface of æolian origin is well shown by the present state of Booby Island and similar barren Cays. Here the surface is covered by grotesque excrescences produced by the wearing away of the softer portions of the rock. Among these projecting masses, many are tubular, the lumen of the tubes ranging from a fraction of an inch to over a foot in diameter. These tubes bifurcate and branch in various ways, and at first sight suggested to the speaker the idea that they might be fulgurites. Close examination shows that the rock of which they are formed consists of minute water-worn grains of calcareous material, comminuted coral and shell, cemented compactly together; in fact, they resemble in structure the rocks of the fertile islands. They are, however, very much hardened on the inner surface and a distinct zone of harder substance is apparent upon fresh transverse fracture.

This vitreous appearance, together with evidence that the tubes had been formed while the sand was in an uncompacted condition, recalled Darwin's description of fulgurites found in a similarly exposed locality near the La Plata[1] and those found at Drigg in Cumberland.[1] Specimens brought to Philadelphia, however, and carefully examined chemically and microscopically go to prove that these tubes are not the result of lightning strokes, and that the hardened interior is not vitrification, but solidification due to partial solution of the loose grains of sand.

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[1] Journ. of Researches into the Nat. Hist. of countries visited during the Voyage of H. M. S. Beagle, Vol. I, p. 76.

Evidence is thus obtained to show that these tubes represent the ramifications of plant roots of a now exterminated flora; plants which existed probably upon the first sands drifted upon the original rocky core. The juices of the roots acting upon the sand inmediately surrounding them formed a compact layer. Through erosion and subsidence the vegetation was afterwards exterminated, the looser particles of the drift rock worn away and the surface left covered by myriads of tubes of all sizes formerly occupied by plant roots and rootlets. The small islands exhibiting these peculiar formations are indications, therefore, of erosion and subsidence, and in the Bahamas, the processes of land destruction and land formation may be seen actively at work. There is reason to believe that the topography of the present islands has undergone great change, and the probabilities of finding a locality in which the present flora represents an undisturbed indigenous growth are slight.

Fossil corals of recent types are found much above high watermark; large caves with their floors above tide level exist, together with many other evidences of land elevation. Many of the islands show the formation of æolian rocks in progress, while in the great bights dividing Andros Island, and elsewhere, the deposition of foraminifera has been so great that former channels and sponging grounds have within very recent years become too shallow for approach. On the whole the Bahamas seem to be growing, but changes in the configuration of the group have also undoubtedly been going on through erosion and local subsidences probably owing to the undermining action of the waves.[2]

The role played by vegetation in determining the character of land surface is again well shown in the so-called " Banana holes, " so abundant in New Providence and other islands, holes varying in size from that of a pint cup to that of a large cistern. They are suggestive of pot holes, but can have no such origin and are evidently not cut out by the waves at any previous period of subsidence. He could account for their formation in but one way, and that is through the action of decaying vegetable matter. Each of these holes contains large quantities of leaves and other vegetable substances which, being kept wet by the heavy rains and by the fresh water elevated by each rising tide (almost all wells have a regular ebb and flow in these porous islands), undergo fermentative changes, by the products of which the soft calcareous rock is dissolved and leaches away. He was interested also in examining sections of exposed coral rock, to find in the minute interstices, between the component grains, actively living protococci, sometimes at a depth of $\frac{1}{12}$–$\frac{1}{6}$ of an inch. Undoubtedly these little plants have much to do with the rapid breaking down of the rock surface.

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[1] Geol. Trans., Vol. ii, p. 528.

[2] Vid. Fewkes, on the Origin of the Present Form of the Bermudas, Proc. Boston Soc. Nat. Hist., Vol. xxiv, 1888, p. 518.

The list of plants was in its original shape placed at his service by Sir Alfred Blake then Governor of the Bahamas.

The speaker had been able to add quite a number of species from his own collections made for the University of Pennsylvania,[1] from a list of plants collected by Prof. F. H. Herrick[2] and from collections made by his friend Dr. Anna H. Searing, of Rochester, New York. While the botany of the Bermudas has been well worked up,[3] no extensive lists have before been prepared for the Bahamas, and he therefore felt justified in presenting the paper recorded by title this evening.

The celebrated botanist Andre Michaux visited these islands over one hundred years ago, and sent to France over nine hundred trees and twenty boxes of seeds. No record exists of these other than this fact, recorded in Michaux's journals. Lists and specimens of many valuable woods and textile plants were sent to the colonial exhibition,[4] together with a series of over sixty beautiful life-size, water-color paintings of many of the more interesting plants made by Mrs. Blake. From time to time notes and reports have been published on special agricultural plants[5] and references to the more striking plants occur in the various popular accounts of the Bahamas and in the various works on the history of these islands. The larger islands, such as Abaco and Andras, could supply much valuable timber, were it not for the difficulty of bringing it from the interior to the harbors. Although surface soil is very scant throughout the islands, the difficulty of cultivation does not consist so much in natural obstacles, as in the lack of enterprise shown by the people and the poor market facilities. The larger growers of pine apples, bananas, etc., are Americans, and the islands present a most inviting place for the employment of American capital and energy. Unlike the Bermudas, deciduous trees are abundant and furnish a natural contribution and aid to cultivation, while the cedar, which retards cultivation, is not of sufficient abundance to have any importance. Large quantities of sea weed are available, which, combined with cave earth and sand, would furnish a cheap and available fertilizer. Most of the West Indies have had their flora greatly enriched by the introduction of exotics through Government or individual influence; the Bahamas, on the other hand, while offering a much more favorable and uniform climate than the Bermudas or the more tropical islands, has been singularly neglected, and formerly cultivated fertile tracts have been allowed to grow up in dense bush or to become denuded of soil. The present Government is making a strong effort to develop the culture of *Agave Mexicana* or Sisal Hemp.* Botanists will find a rich and almost untouched field in the cryptogamic flora of these islands, especially in the Algæ.

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[1] Vid. Preliminary Abstract Report of the Marine Laboratory, Ann. Report of the Provost for 1887.

[2] Flora of Abaco and Adjoining Islands, Johns Hopkins Univ. Circ., Vol. vi, p. 46.

[3] The Botany of the Bermudas by Sir John Henry Lefroy, F. R. S., Bull. U. S. Nat. Mus., No. 25, Part II, 1884.

Plants of the Bermudas, or Somers Islands, by Oswald A. Reade, Royal Gazette Office, Hamilton, Bermuda, 1885.

On the Lichens of the Islands of the Atlantic Ocean (Bermuda) Journ. Linn. Soc. (Botany), Vol xiv, p. 366, by J. Stirton.

On the Lichens collected during the Challenger Expedition, ibid., xvi, by J M. Crombie.

Notes on the Vegetation of the Bermudas. On the Marine Algæ of St. Thomas and the Bermudas, by H. N. Moseley, ibid., xiv, p. 311, 317.

On the Marine Algæ of St. Thomas and the Bermudas by George Dickie, ibid., Vol. xiv, p. 312.

[4] Commercial and Technical Report on West Indian and British Honduras Products at the Colonial and Indian Exhibition, 1886. Wm. Clowes and Son, London.

[5] Local Notes on Science and Agriculture, Four Series, Nassau Guardian, 1886, by John Gardiner. Report on the Agricultural condition and prospects of the Bahamas, Nassau N. P. April 17, 1886, by John Gardiner.

The Sand-Dunes of Lewes, Del.—Prof. J. T. Rothrock spoke briefly of the dunes at Lewes, Delaware, and illustrated his statements by some photographs, recently taken by him at that place.

It may be stated in advance that, while the conspicuous change in the surface has been most marked toward Cape Henlopen, the marshes between the Breakwater and the mouth of Lewes Creek have been slowly rising: that whereas a few years ago these marshes were a large number of times overflowed each year, that now this occurs so seldom that the flats are being built upon, and regular crops of marsh hay taken from them. South of the Breakwater, and say one fourth of a mile inland, one encounters a mass of pure shore sand, probably in its greatest depth one hundred feet deep, becoming on the north and south and west less and less deep until one reaches nearly the sea-level. On top of this ridge the dead trunks of former forests rise out of the sand. On the northern slope they become less and less abundant, disappearing when one reaches the marsh level. North of this, toward the water's edge a second growth of trees is seen appearing. On the southern slope of the ridge a forest of *Pinus rigida* stands, but this forest, by the moving of the sand toward the south, is being constantly encroached upon.

Indeed, at present one may there see trees standing on the natural level, in no wise surrounded or endangered by sand. A few yards to the north of these is the face of the advancing sand hill. There one finds the Pines in all stages of burial, from those whose roots are barely touched, to those (sixty to eighty feet high) whose

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* Report of George Preston, Esq., as Special Commissioner to Yucatan to Inquire into the working of the Fibre Industry in that Country. Nassau. N. P., 1888.